



Softener Regeneration with Salt Saver Dosages

Technical Bulletin 4-006 Pretreatment

Softener Operating Costs

The cost of operating a softener primarily depends on the cost of the salt and water used for regeneration. An obvious means of minimizing cost is to make sure that no more than 15 pounds of salt per cubic foot of resin is used and the proper regeneration flow rates are employed. Salt dosages greater than 15 lbs/ft³ do not significantly increase capacity. Excessive flow rates not only waste water, but can also reduce regeneration efficiency. Another way to minimize operating costs is to use salt saver dosages.

Salt Saver Dosages

Salt saver dosages are based on the fact that softening capacity does not decrease proportionally with a reduction in the amount of salt used for regeneration. For example

Capacity (grains/ft ³ resin)	Salt Dosage (lbs/ft ³ resin)	Regeneration Efficiency (grains/lbs salt)
30,000	15.0	2,000
25,000	10.0	2,500
22,000	7.5	2,933
18,200	4.0	4,550

A 50% reduction in salt usage only reduces softening capacity by 27%. Lower salt dosages require more frequent regenerations.

Cost Analysis

Whether more frequent regeneration with lower salt dosages is economically attractive depends on factors like the soft water requirements, water cost, water availability, salt cost, influent hardness, desired effluent hardness, and softener design. One drawback to using less than 15 pounds salt/ft³ of resin is that hardness leakage can occur if the softener is not properly regenerated. For this reason, a salt dosage of 10 lbs/ft³ is often used. This reduces the potential for leakage over using 7.5 lbs/ft³ while still providing a significant salt savings. However, if the influent hardness is very high and the flow rates are near design capacity, salt saver dosages may not be practical due to hardness leakage throughout the softener run. Also be aware that a restriction on groundwater withdrawal or plant discharge might rule out more frequent softener regeneration, regardless of the salt savings. Furthermore, salt saver dosages are probably not desirable if the softeners are sized so that increased regeneration means they will have to be regenerated more than once per day. In spite of these limitations, salt saver regeneration can be effectively used to reduce softener operating costs in many facilities. They can be especially beneficial for oversized softeners as the increased regeneration frequency can help reduce bed fouling and channeling.

Procedure

The following general procedure can be used to set up a softener on a salt saver dosage

1. Measure the diameter (if round) or the length and width (if square or rectangular) of the brine tank in inches
2. Calculate the pounds of salt per inch of brine draw (assumes 95% saturated brine)
 - If round: (diameter)² x 0.008518
 - If rectangular: length x width x 0.01085
3. Determine how many inches of brine need to be drawn for the desired salt dosage
$$\frac{\text{ft}^3 \text{ resin per tank} \times \text{salt dosage in lbs/ft}^3}{\text{lbs salt/inch}}$$



4. Set the brine draw rate
- If the salt dosage is 15 lbs/ft³, set the brine draw rate so the above inches of brine are drawn over about 20 minutes
 - If the salt dosage is 10 lbs/ft³, set the brine draw rate so the above inches of brine are drawn over about 13 minutes
 - If the salt dosage is 7.5 lbs/ft³, set the brine draw rate so the above inches of brine are drawn over 10 minutes
 - If the salt dosage is 4.0 lbs/ft³, set the brine draw rate so the above inches of brine are drawn over 6 minutes.

Example

Consider a dual tank softener (15 ft³ resin per tank) with the following design flow rates

Regeneration Step	Flow Rate (gpm)	Duration (Minutes)	Gallons Required
Backwash	28.0	15 (1)	375
Brine Draw	13.5 (2)	20	270
Slow Rinse	9.0	20	180
Fast Rinse	28.0	10 (3)	280
Total Water Usage per Regeneration			1,105

Question One: If the brine tank is 38" in diameter (round), how many inches of brine would have to be drawn over what period of time for regeneration at a 10 lbs/ft³ salt dosage?

$$\text{lbs salt/inch brine} = (\text{tank diameter})^2 \times 0.008518 = 38^2 \times 0.008518 = 12.3 \text{ lbs salt/inch brine}$$

$$\text{Inches of brine} = \frac{\text{ft}^3 \text{ resin per tank} \times \text{salt dosage in lbs/ft}^3}{\text{lbs salt/inch brine}} = \frac{15 \times 10}{12.3} \approx 12 \text{ inches in 13 minutes}$$

Question Two: If salt costs \$12.00 per 80 pound bag, water costs \$4.00 per 1,000 gallons, the raw water hardness is 6 gpg, and the annual soft water requirement is 20,000,000 gallons, what is the annual salt and water savings associated with regeneration at a salt dosage of 10 lbs/ft³ rather than 15 lbs/ft³?

At 15 lbs salt/cubic foot of resin

$$\begin{aligned} & \frac{30,000 \text{ grains ft}^3}{6 \text{ gpg}} \times 15 \text{ ft}^3 = 75,000 \text{ gal soft water per regeneration} \\ & \frac{20,000,000 \text{ gal water/yr}}{75,000 \text{ gal per regen.}} = 267 \text{ regenerations per year} \\ & 15 \text{ lbs salt per ft}^3 \text{ resin} \times 15 \text{ ft}^3 \text{ resin} = 225 \text{ lbs salt per regeneration} \\ & 225 \text{ lbs salt per regen.} \times 267 \text{ regen. per year} = 60,075 \text{ lbs salt per year} \\ & 60,075 \text{ lbs salt per year} \times \$0.15 \text{ per lb salt} = \$9,011 \text{ per year salt cost} \\ & 1,105 \text{ gal water per regen.} \times 267 \text{ regen. per year} = 295,035 \text{ gal per year} \\ & 295,035 \text{ gal per year} \times \$4.00 \text{ per 1,000 gal} = \$1,180 \text{ per year water cost} \end{aligned}$$

At 15 lbs salt/cubic foot of resin:
Salt cost + water cost = \$10,191 per year

At 10 lbs salt/cubic foot of resin

$$\begin{aligned} & \frac{25,000 \text{ grains ft}^3}{6 \text{ gpg}} \times 15 \text{ ft}^3 = 62,500 \text{ gal soft water per regeneration} \\ & \frac{20,000,000 \text{ gal water/yr}}{62,500 \text{ gal per regen.}} = 320 \text{ regenerations per year} \\ & 10 \text{ lbs salt per ft}^3 \text{ resin} \times 15 \text{ ft}^3 \text{ resin} = 150 \text{ lbs salt per regeneration} \\ & 150 \text{ lbs salt per regen.} \times 320 \text{ regen. per year} = 48,000 \text{ lbs salt per year} \\ & 48,000 \text{ lbs salt per year} \times \$0.15 \text{ per lb salt} = \$7,200 \text{ per year salt cost} \\ & 1,105 \text{ gal water per regen.} \times 320 \text{ regen. per year} = 353,600 \text{ gal per year} \\ & 353,600 \text{ gal per year} \times \$4.00 \text{ per 1,000 gal} = \$1,414 \text{ per year water cost} \end{aligned}$$

At 10 lbs salt/cubic foot of resin:
Salt cost + water cost = \$8,614 per year

Annual Savings = \$1,577.00 (a 16% decrease in operating costs)

Notes

1. Backwash time is based on how long it takes to produce clear water going to the drain (can be as short as 10 minutes or much longer than 15 minutes, depending on suspended solids content of the raw water and available water pressure).
2. Brine draw flow rate = 4.5 gpm flow from brine tank + 9 gpm flow to the ejector.
3. The fast rinse time should be adjusted so the chloride level of the rinse water is equal to the chloride level of the raw water. This may require more than 10 minutes.

